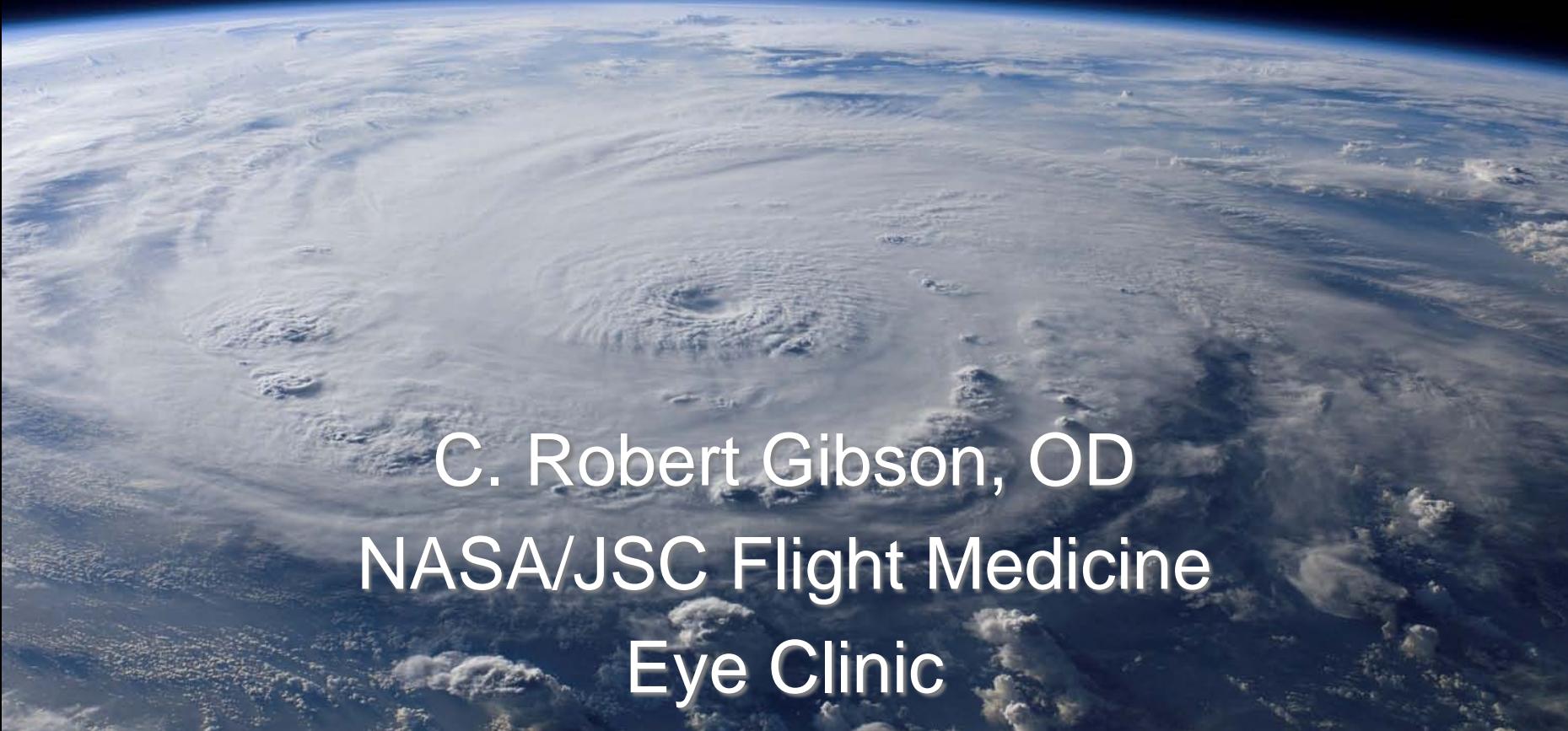


NASA Papilledema Summit

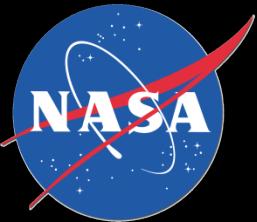
July 27-28, 2009



Background: preflight screening, in-flight capabilities, & postflight testing

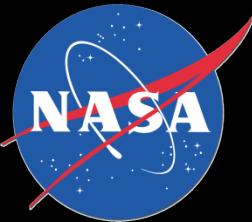


C. Robert Gibson, OD
NASA/JSC Flight Medicine
Eye Clinic



Astronaut Selection

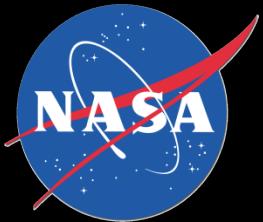
- ❖ Since 1959, more than 300 men and women have been selected for service in the U.S. Space Program as pilots, mission specialists, or payload specialists.
- ❖ In the early years of the U.S. Space Program, all astronauts were military test pilots and thus were required to meet the rigorous vision standards of the military.
- ❖ Because vision is critical for astronaut function and survival, the eyes of astronaut candidates are thoroughly evaluated with standard and specialized equipment.



Current Astronaut Selection Vision Exam:



- ❖ Uncorrected Visual Acuity
- ❖ Manifest Refraction
- ❖ Cycloplegic Refraction
- ❖ Color Vision (PIP)
- ❖ Stereopsis (OPTEC, Randot)
- ❖ NPA (Accommodation)
- ❖ NPC (Convergence)
- ❖ Red Lens Test
- ❖ Pupils
- ❖ Heterophoria (Cover Test)
- ❖ IOP (Applanation)
- ❖ Biomicroscopy
- ❖ Ophthalmoscopy
- ❖ Retinal Photography
- ❖ Visual Fields (Humphrey 30-2)
- ❖ Corneal Topography



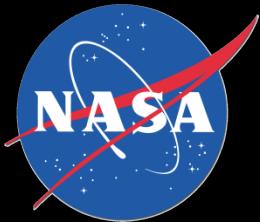
Pilot - Eye Standards

	Jan 1977	Dec 1983	Oct 1988	Jun 1991	Aug 1995	Feb 1997	Jul 1998	Mar 1999	Mar 2009
DVA	20/50	20/50	20/50	20/50	20/50	20/70	20/70	20/100	NA
Refract- ion	+1.75 -1.00	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+3.50 -4.50
Astig- matism	1.25 NA	3.00 DQ	2.00						
Depth Percep.	Y	Y	Y	Y	Y	Y	Y	Y*	Y*
Color Vision	Y	Y	Y	Y	Y	Y	Y	Y**	Y**
Ortho-K	NA	DQ	DQ 2YR	DQ 2YR	DQ 6MO	DQ 6MO	DQ 6MO	DQ 6MO	DQ 6MO
Refract Surgery	NA	DQ	A***						

*Stereopsis testing changed from Verhoeff to Optec 2300

**Color Vision testing changed to Dvorine PIP with FALANT as secondary test

***LASIK and PRK approved for selection and retention



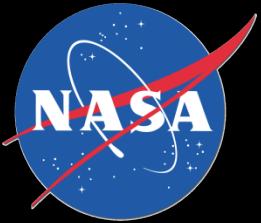
Mission Specialist - Eye Standards

	Jan 1977	Dec 1983	Oct 1988	Jun 1991	Aug 1995	Feb 1997	Jul 1998	Mar 1999	Mar 2009
DVA	20/50	20/100	20/100	20/150	20/200	20/200	20/200	20/200	NA
Refract- ion	+2.50 -2.00	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50	+/-5.50
Astig- matism	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Depth Percep.	Y	Y	Y	Y	Y	Y	Y	Y*	Y*
Color Vision	Y	Y	Y	Y	Y	Y	Y	Y**	Y**
Ortho-K	NA	DQ	DQ 2YR	DQ 2YR	DQ 6MO	DQ 6MO	DQ 6MO	DQ 6MO	DQ 6MO
Refract Surgery	NA	DQ	A***						

*Stereopsis testing changed from Verhoeff to Optec 2300

**Color Vision testing changed to Dvorine PIP with FALANT as secondary test

***LASIK and PRK approved for selection and retention

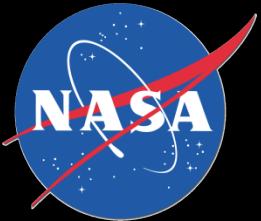


NASA Vision Standards (Astronaut Selection)



Retina and Vitreous

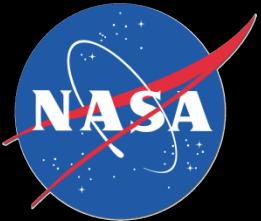
- History or presence of retinal detachment, unless traumatic with no sequelae, retinal tears, or edema.
- Retinal hole with presence of fluid or vitreous traction. Other retinal holes require ophthalmic evaluation.
- Degeneration or dystrophies of the central or peripheral retina, including lattice degeneration, require ophthalmic evaluation.
- Pigmentary degeneration requires ophthalmic evaluation.
- Retinitis, chorioretinitis, or other inflammatory conditions of the retina, unless single episode that has healed and does not impair central or peripheral vision.
- Hemorrhages, exudates, or other retinal vascular conditions that potentially impair vision require ophthalmic evaluation.
- Vitreous opacities or conditions that may cause loss of central acuity or peripheral visual field require ophthalmic evaluation.



NASA Vision Standards

Optic Nerve

- ❖ **Presence or history of optic neuritis**
- ❖ Optic atrophy, primary or secondary.
- ❖ History of papilledema, pseudopapilledema, or papillitis requires ophthalmic evaluation.
- ❖ Congenito-hereditary conditions, including optic nerve drusen, that may interfere with central visual acuity or visual field.



NASA Vision Standards

Intraocular Pressure

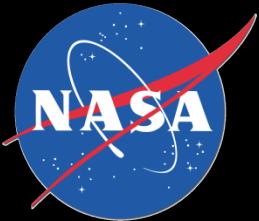
- ❖ Glaucoma, identified by pressure greater than 30 mmHg in either eye, characteristic glaucomatous change in the optic nerve or visual field loss characteristic of glaucoma.
- ❖ Preglaucoma, identified by pressure on two determinations equal to or greater than 25 mmHg or a difference greater than 4 mmHg between eyes.
- ❖ Pigmentary Dispersion Syndrome requires ophthalmic evaluation.



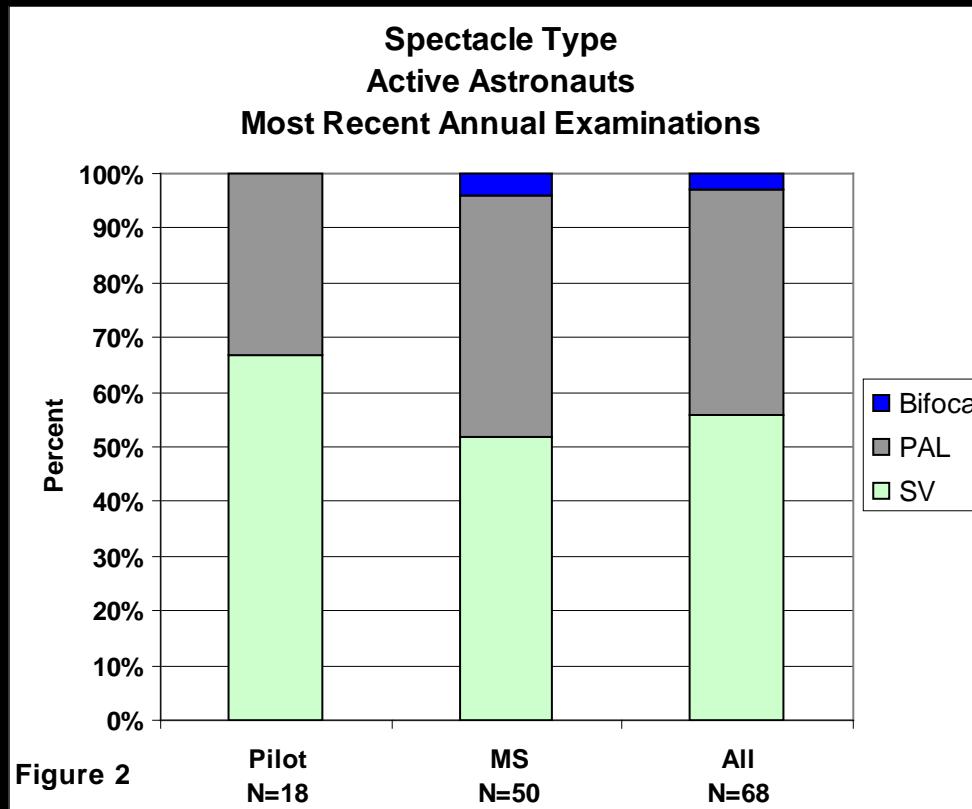
Astronaut Demographics

Active NASA Astronauts	Pilot	MS	All
N	28	65	93
Mean Age	47	48	48

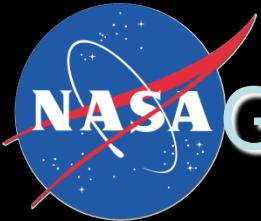
- 74 males, 19 females
- 9 recently selected astronaut candidates
- 29 ISS Expedition crew members (long duration)
- Between 1989 and 2009, there have been 478 STS (shuttle) crew members (short duration)



Astronaut Demographics

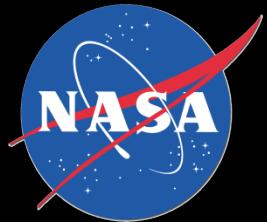


The percentage of spectacle types among active astronauts with a spectacle prescription, categorized as bifocal lens, progressive addition lens (PAL), or single vision lenses (SV). The astronauts are categorized as pilots and mission specialists (MS).



General Vision Issues of Space Flight

- ❖ Majority of Astronauts are Presbyopic
- ❖ 79% Wear Vision Correction (32% of which wear contact lenses)
- ❖ ~90% Wear Correction In Space
- ❖ 41% Wear Multifocal Prescriptions
- ❖ Hypercritical Observers!!!
- ❖ Critical Tasking / No Margin for Error
- ❖ Many Wear Varied Types of Correction based on tasks (NBL, Simulator, T-38, Space)



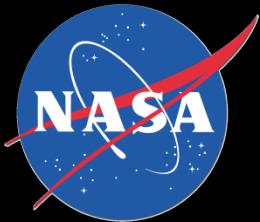
Simulator





Russian Soyuz Spacecraft





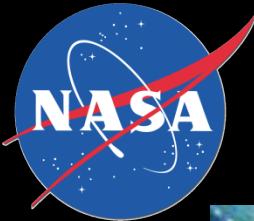
T-38



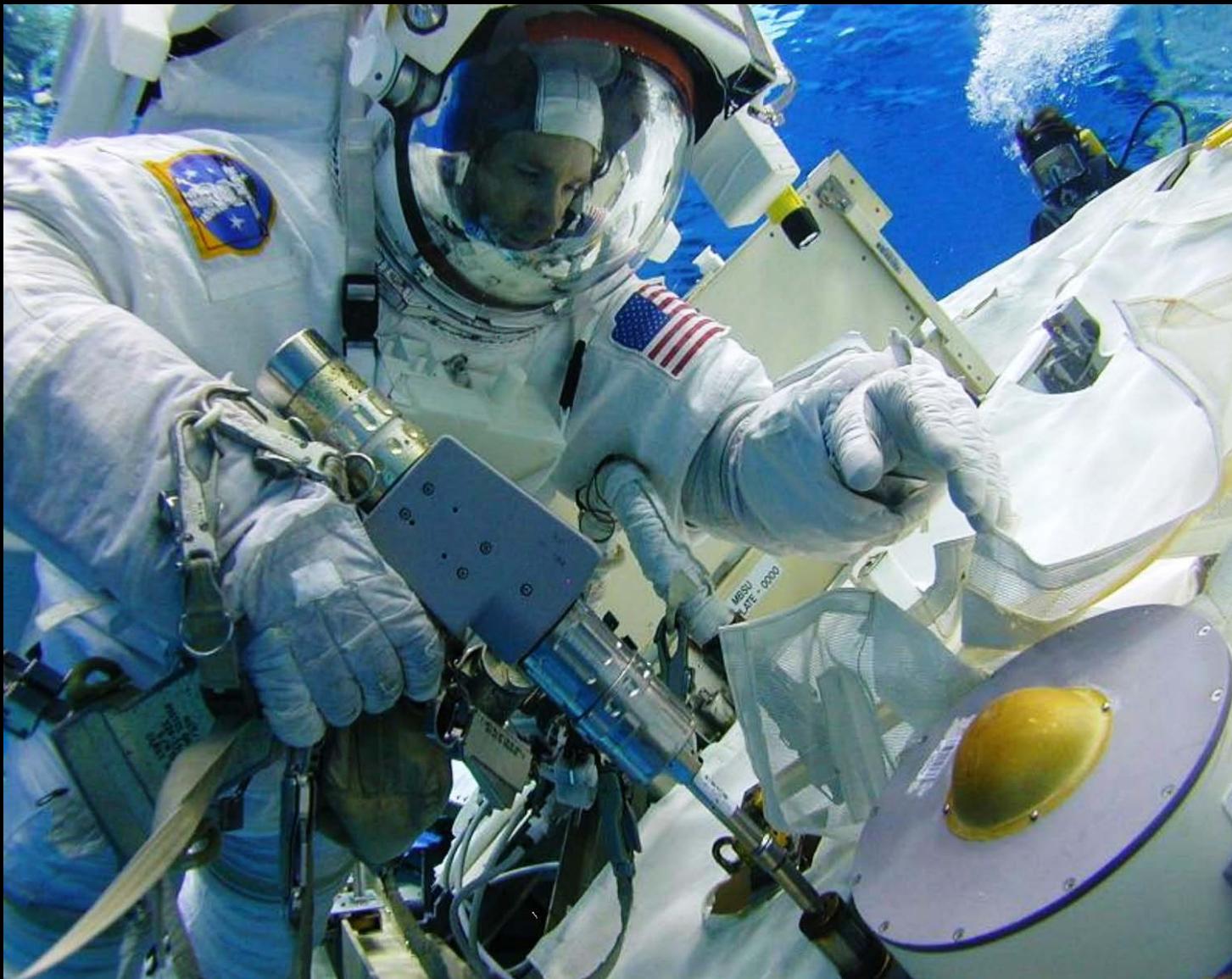


T-38 Cockpit



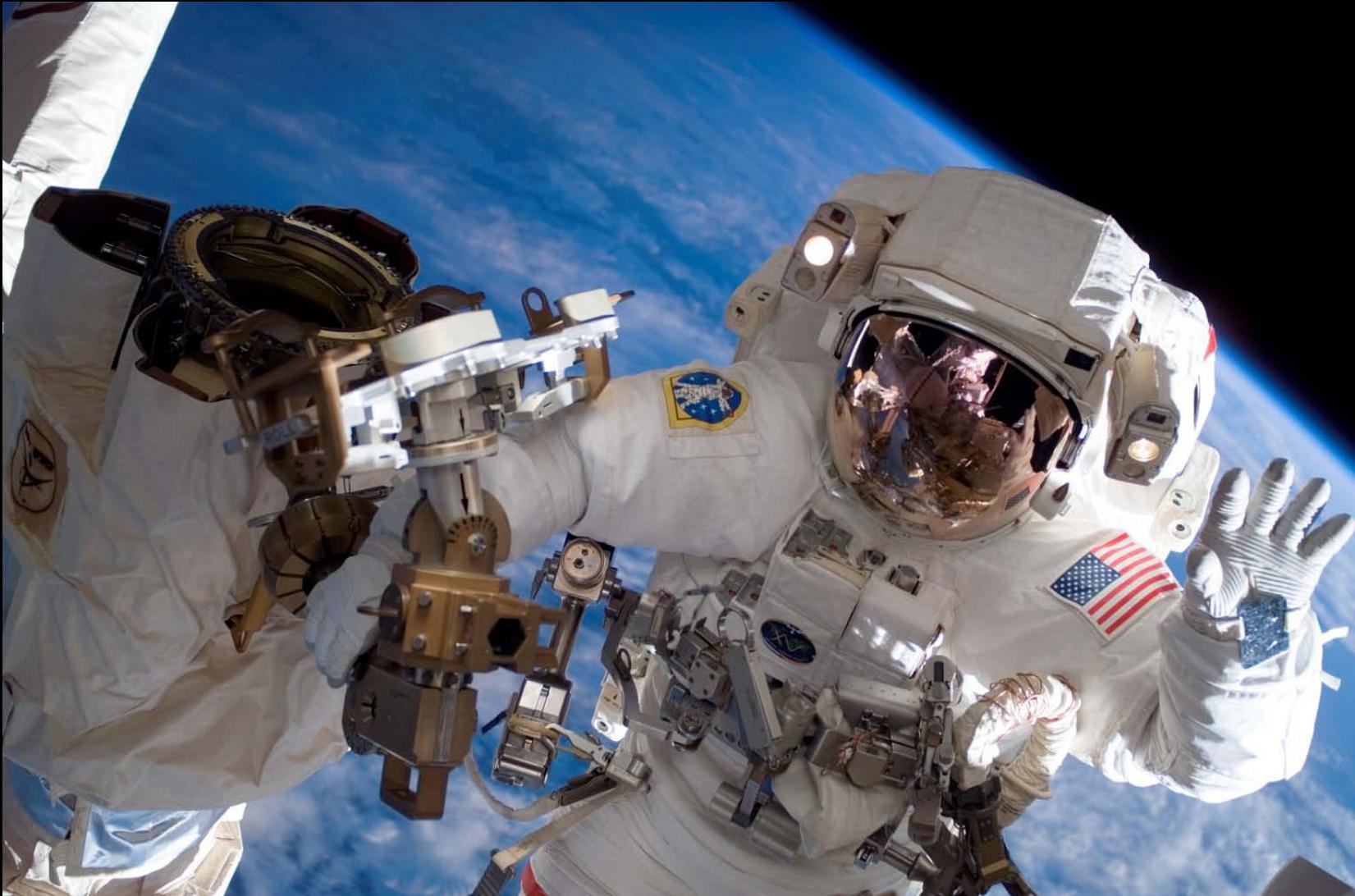


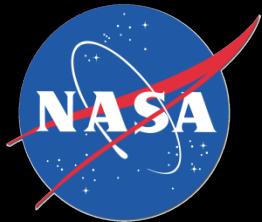
Neutral Buoyancy Lab (NBL)



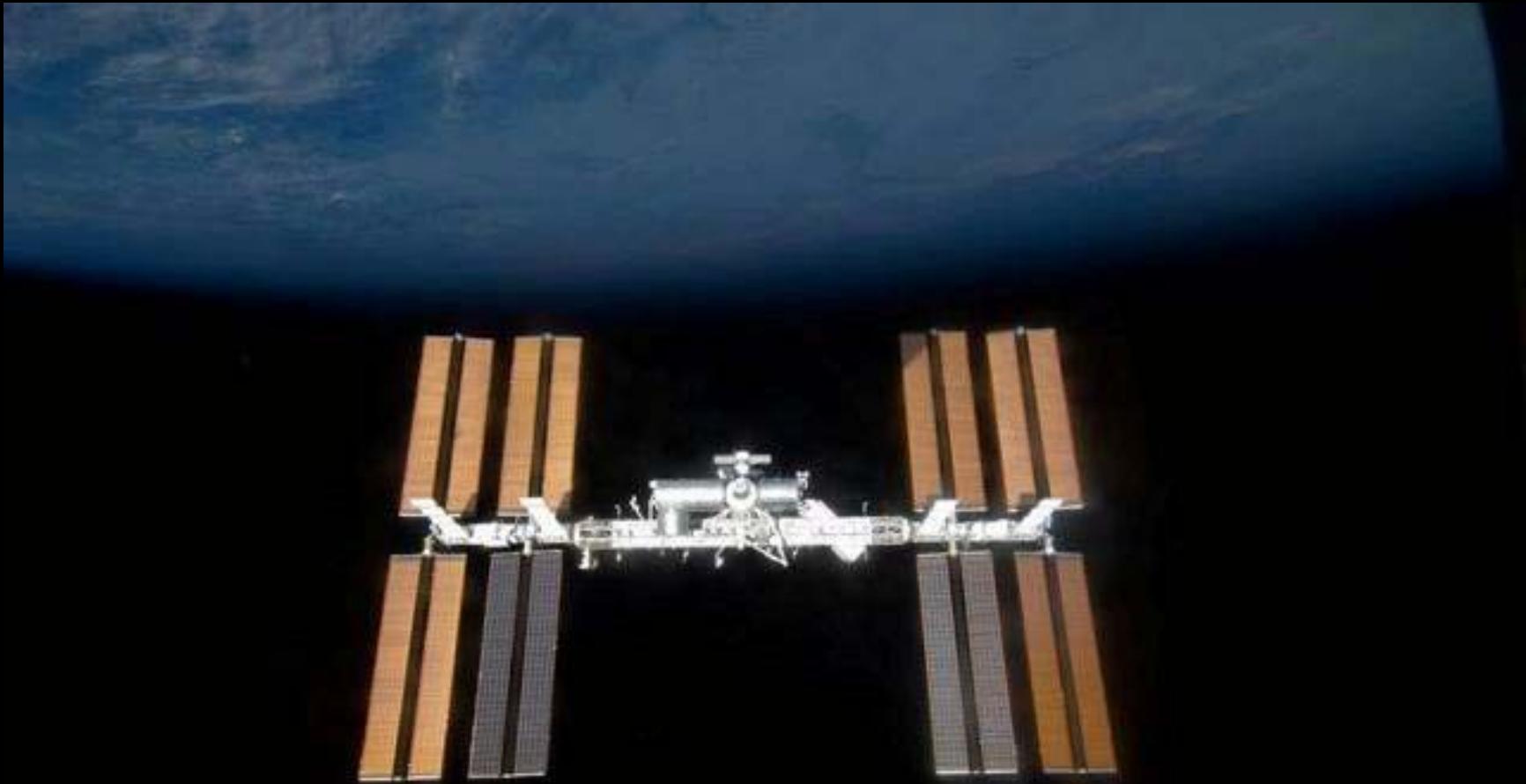


Extravehicular Activity (EVA)



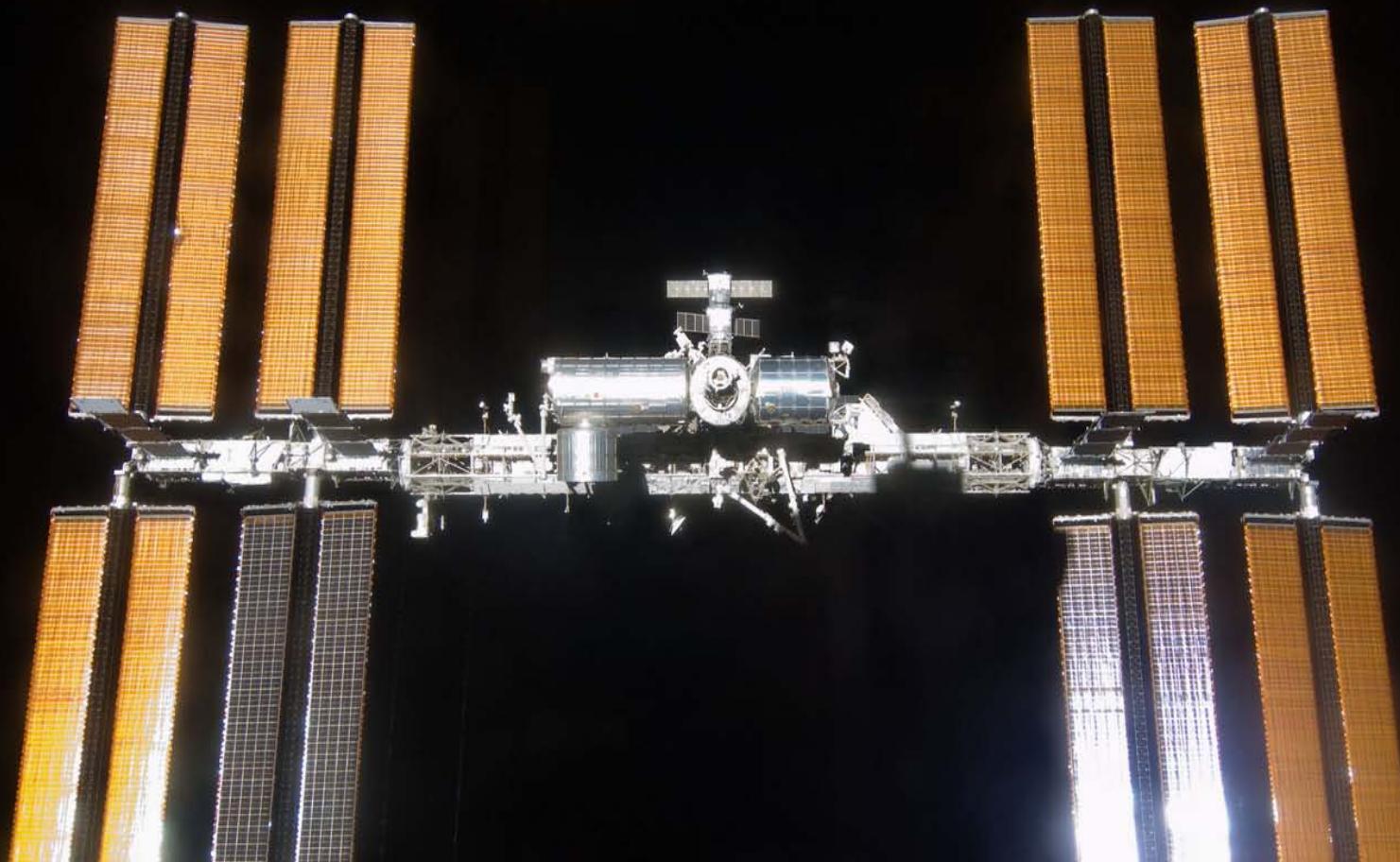


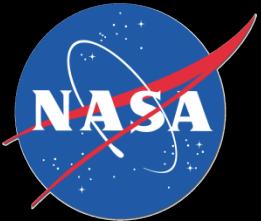
International Space Station (ISS)





ISS





International Space Station

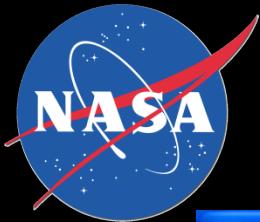


ISS017E012258



View from ISS window





Annual, Preflight & Postflight Eye Exam



Vision Exam - Flight: Patient #3 qqTest

History/Rx | VF/Amsler | Refraction/VA | PH/CV/DP | IOP/Oc Health | Fit Data | Assess/Plan | Dx/Handouts

HISTORY

Previous Findings

Purpose of Exam: Postflight Vision Exam

Mission: Expedition

Exam Description: R+0

ID #: []

Eye Color: Blue

Rating/Specialty: NASA Pilot

Qualified For: NASA Class I

Complaint: None

Personal Ocular History:

Family Ocular History:

- Reviewed - FH negative
- Glaucoma
- Macular Degeneration
- Cataracts - Early onset

Family History Comments

CORRECTION MODE

None

Corrected

Spectacle Type: Single Vision-Distance

CL Type: Distance

CL Material:

- Rigid Gas Permeable
- Soft Contact Lens

CL Design:

- Spherical
- Toric

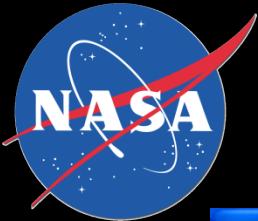
CL Schedule:

- DW
- CW

Prev Form (Ctrl+PgUp)

Next Form (Ctrl+PgDn)

Close



Annual, Preflight & Postflight Eye Exam

Vision Exam - Flight: Patient #3 qqTest

History/Rx

VF/Amsler

Refraction/VA

PH/CV/DP

IOP/Oc Health

Fit Data

Assess/Plan

Dx/Handouts

VISUAL FIELDS

Confrontation Testing Results

<input checked="" type="checkbox"/> Confrontation Testing	Confrontation Testing Results: <input type="text" value="Normal"/>
<input type="checkbox"/> Automated (Humphrey) Testing	
<input type="checkbox"/> Frequency Doubling Testing	
<input type="checkbox"/> Other	

Visual Field
Comments:

AMSLER GRID

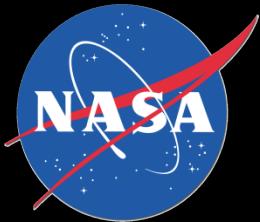
- | | |
|------------------------------------|--|
| <input type="checkbox"/> Right Eye | |
| <input type="checkbox"/> Left Eye | |

Amsler Grid
Comments:

Prev Form (Ctrl+PgUp)

Next Form (Ctrl+PgDn)

Close

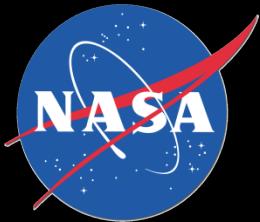


Annual, Preflight & Postflight Eye Exam



Vision Exam - Flight: Patient #3 qqTest

History/Rx	VF/Amsler	Refraction/VA	PH/CV/DP	IOP/Oc Health	Fit Data	Assess/Plan	Dx/Handouts
VISUAL ACUITY							
Previous Findings							
DISTANT VISION				REFRACTION			
RE 20/ [100]	CORR TO	20/[20]		RE [-2.00]	S	-1.00	C X 100
LE 20/ [100]	CORR TO	20/[20]		LE [-2.50]	S	-0.50	C X 090
OU 20/ []	CORR TO	20/[]					
NEAR VISION				"INTERMEDIATE VISION"			
RE 20/ [20]	CORR TO	20/[20]	By [1.50]	PC [20]	mm	RE 20/ [30]	CORR TO 20/[20]
LE 20/ [20]	CORR TO	20/[20]	By [1.50]	Accom.		RE [4] LE [4]	LE 20/ [30] CORR TO 20/[20]
OU 20/ []	CORR TO	20/[]				OU 20/ []	CORR TO 20/[]
LOGMAR ACUITY				Calculate			
High Contrast - Corrected				Low Contrast - Corrected			
RE		LE		RE		LE	
# Correct:	[60]	_____	[60]	# Correct:	[45]	_____	[45]
LogMar:	[0.10]	_____	[0.10]	LogMar:	[0.20]	_____	[0.20]
VA:	[15.89]	_____	[15.89]	VA:	[31.70]	_____	[31.70]
High Contrast - Uncorrected				Low Contrast - Uncorrected			
RE		LE		RE		LE	
# Correct:	[]	_____	[]	# Correct:	[]	_____	[]
LogMar:	[]	_____	[]	LogMar:	[]	_____	[]
VA:	[]	_____	[]	VA:	[]	_____	[]
Visual Acuity Comments:							



Annual, Preflight & Postflight Eye Exam

Vision Exam - Flight: Patient #3 qqTest

History/Rx VF/Amsler Refraction/VA PH/CV/DP IOP/Oc Health Fit Data Assess/Plan Dx/Handouts

Previous Findings

HETEROPHORIA

ES EX RH LH Present Absent

TROPIA

PUPILS

WNL Abn Not Eval WNL Abn Pass Fail

VERSIONS

RED LENS TEST

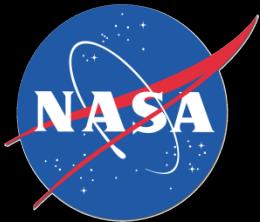
COLOR VISION

Test 1 Score: of Result Pass Fail Test Used Corrected Yes No
Test 2 Score: of Result Pass Fail Test Used Corrected Yes No

DEPTH PERCEPTION

Test 1 Score: of Result Pass Fail Test Used Corrected Yes No
Test 2 Score: of Result Pass Fail Test Used Corrected Yes No

Comments:



Annual, Preflight & Postflight Eye Exam



Vision Exam - Flight: Patient #3 qqTest

History/Rx | VF/Amsler | Refraction/VA | PH/CV/DP | **IOP/Oc Health** | Fit Data | Assess/Plan | Dx/Handouts

INTRAOCULAR TENSION

Previous Findings

Test 1

RE [20]	mm Hg	Test TAP	RE [] mm Hg	Test [] mm Hg
LE [20]	mm Hg	Comments	LE [] mm Hg	

Test 2

OCULAR HEALTH

0=Clear, 1=Trace, 2=Mild, 3=Moderate, 4=Severe

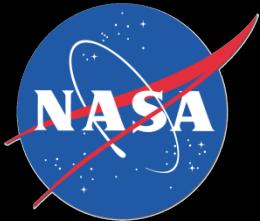
Fundus Dilated Undilated

Pt. advised no activities involving flying x 24 hours from time dilating drops used.

Lids/Lashes	RE [0] Clear	LE [0] Clear	Media	RE [0] Clear	LE [0] Clear
Conjunctiva	RE [0] Clear	LE [0] Clear	Optic Nerve	RE [0] Clear	LE [0] Clear
Cornea	RE [0] Clear	LE [0] Clear	Macula	RE [0] Clear	LE [0] Clear
Iris	RE [0] Clear	LE [0] Clear	Vasculation	RE [0] Clear	LE [0] Clear
Lens	RE [0] Clear	LE [0] Clear	Fundus/Periph	RE [0] Clear	LE [0] Clear
Comments:	Comments				

LENS: LOCS III

	RE	LE
Color:	[0]	[1]
Opal:	[2]	[3]
Cortical:	[4]	[5]
Post SC:	[6]	[7]



Annual, Preflight & Postflight Eye Exam



Vision Exam - Flight: Patient #3 qqTest

History/Rx VF/Amsler Refraction/VA PH/CV/DP IOP/Oc Health Fit Data Assess/Plan Dx/Handouts

Normal Findings

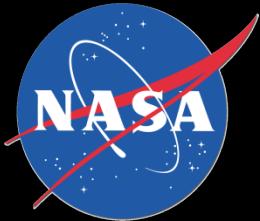
SUBJECTIVE FINDINGS

	RE	LE
Decreased DVA	<input type="button" value="1) Mild"/>	<input type="button" value="1) Mild"/>
Increased DVA	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Decreased NVA	<input type="button" value="2) Moderate"/>	<input type="button" value="3) Severe"/>
Increased NVA	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Eye Strain	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Eye Irritation	<input type="button" value="1) Mild"/>	<input type="button" value="1) Mild"/>
Headache	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Dry Eye	<input type="button" value="1) Mild"/>	<input type="button" value="1) Mild"/>
Foreign Body	<input type="button" value="1) Mild"/>	<input type="button" value="1) Mild"/>
Poor Air Quality	<input type="button" value="1) Mild"/>	<input type="button" value="1) Mild"/>

OBJECTIVE FINDINGS

Keratitis	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Corneal Ulcer	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Subconjunctival Hemorrhage	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Conjunctivitis	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Refraction Change	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Phoria Change	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Accommodation Change	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Stereo	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>
Other	<input type="button" value="0) No"/>	<input type="button" value="0) No"/>

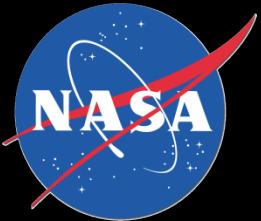
Inflight Comments:



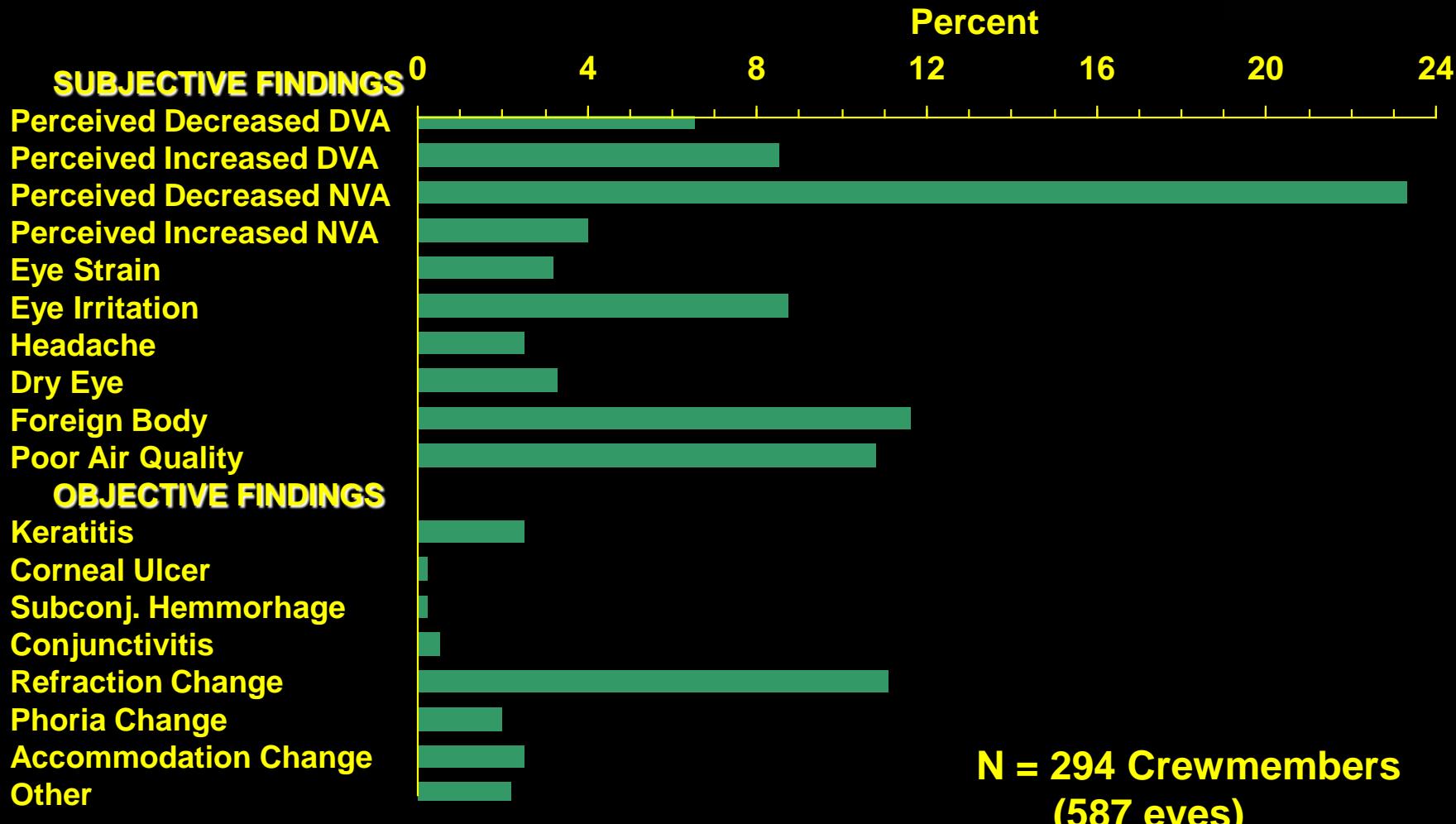
Annual, Preflight & Postflight Eye Exam

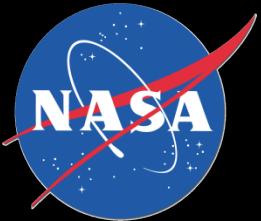
Vision Exam - Flight: Patient #3 qqTest

History/Rx	VF/Amsler	Refraction/VA	PH/CV/DP	IOP/Oc Health	Fit Data	Assess/Plan	Dx/Handouts
STANDARDS/ASSESSMENT/PLAN							
Previous Findings							
Standards:				Waiver granted:			
<input checked="" type="checkbox"/> Meets all ocular standards <input type="checkbox"/> Meets all ocular standards w/spectacles <input type="checkbox"/> Meets ocular standards w/waiver <input type="checkbox"/> Does not meet ocular standards				1.2.3.4			
Assessment:							
Plan:							

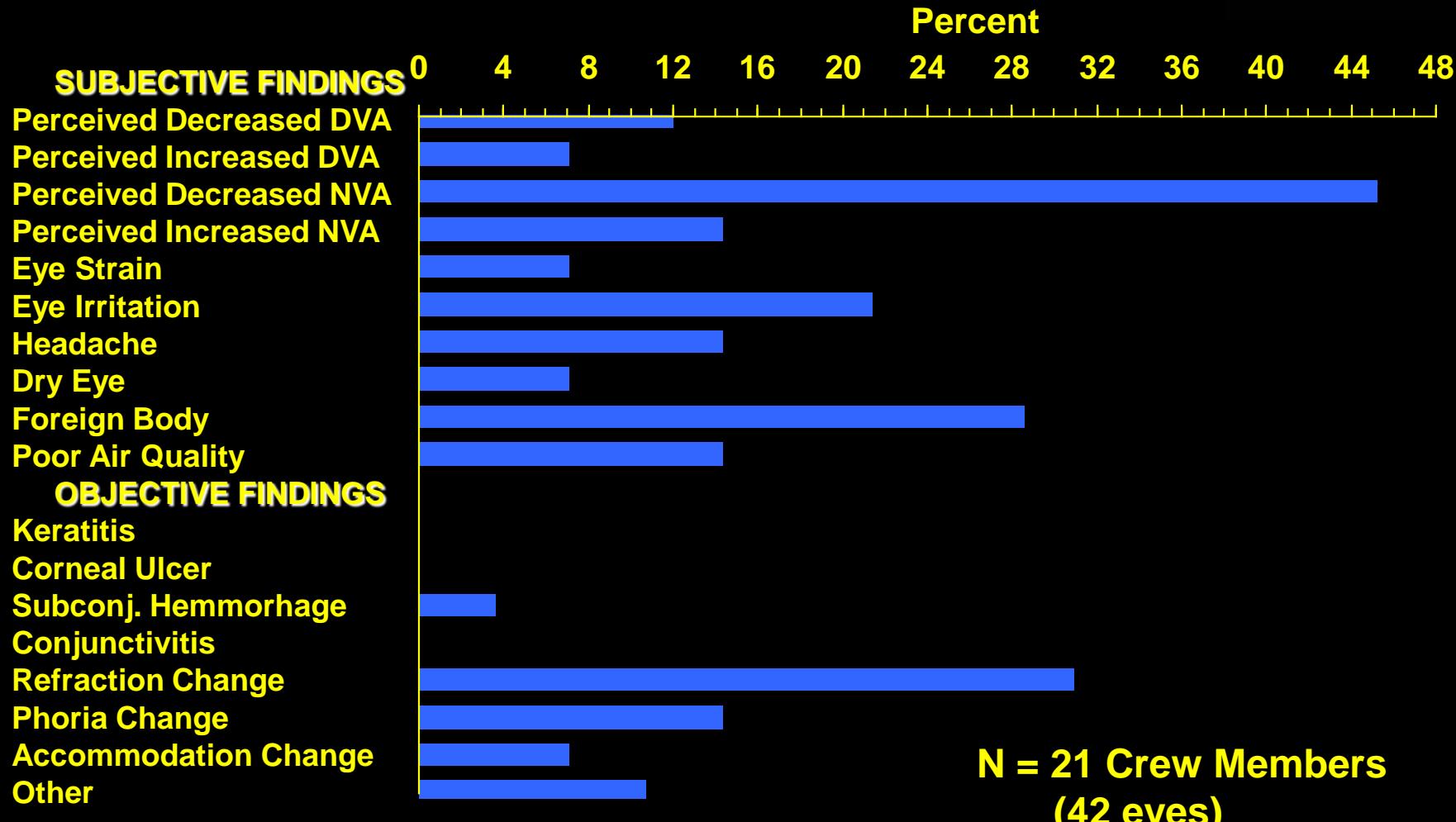


Postflight Ocular Findings Shuttle Crew Members Only





Postflight Ocular Findings ISS Expedition Crewmembers Only





Preflight, In-Flight, & Postflight Testing (ISS)

Medical Requirements for long-duration space flight. Medical Evaluation Document (MEDB 1.10 Ophthalmology Exam):

- **Purpose/Objectives:** To assess the status of ophthalmic health and function pre- and postflight.
- **Flight Duration:** \geq to 30 days (4-6 months)
- **Type of crew:** All ISS primary crewmembers and backup crewmembers
- **Test locations:** Johnson Space Center, Coastal Eye Associates



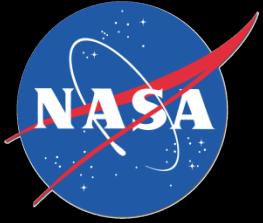
Preflight, In-Flight, & Postflight Testing (ISS)



Preflight Testing:

An eye examination will be conducted preflight by a specialist (L-90/45 days). The examination will include:

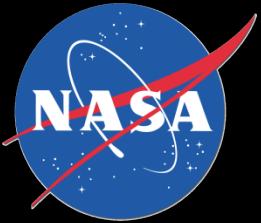
- Refraction (**cycloplegic**)
- Best Corrected Visual Acuity
- Tonometry
- Automated Visual Fields
- Dilated Fundoscopy
- Contact Lens / Spectacle Storage Plan
- Amsler Grid Testing
- **Pupil reflexes**
- Extraocular muscle assessment
- Biomicroscopy (slit lamp)
- Retinal photography
- Optical coherence tomography (OCT)
- AScan



Preflight, In-Flight, & Postflight Testing (Cont'd)



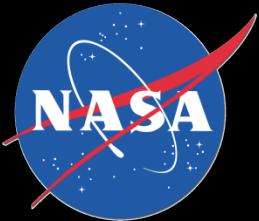
- In-Flight Testing: None



Preflight, In-Flight, & Postflight Testing (Cont'd)

Postflight Testing:

- **R+0/1: Eye Examination**, which includes ophthalmoscopic exam, conducted by flight surgeon.
- **R+3 days (or ASAP): Eye examination conducted postflight by a specialist. The examination will include:**
 - Best Corrected Visual Acuity
 - Tonometry
 - Pupil Reflexes
 - Extraocular Muscle Assessment
 - Biomicroscopy (Slit Lamp)
 - Survey
 - Amsler Grid Testing
 - Refraction(manifest and cycloplegic)
 - Retinal photography
 - Optical coherence tomography(OCT)
 - AScan
 - Automated Visual Fields
 - Dilated Fundoscopy



Current In-Flight Capabilities (ISS)

❖ We currently have limited in-flight capabilities on board the International Space Station for performing an internal ocular health assessment.

- Visual Acuity
- Direct Ophthalmoscope
- Ultrasound
- Tonometry (Tonopen):





In-flight Recommendations

- ❖ Recommendations for minimal in-flight capabilities:
 - **Retinal Imaging** – provide in-flight capability for the visual monitoring of ocular health (specifically, imaging of the retina and optic nerve head) with the capability of downlinking video/still images.
 - **Tonometry** – provide more accurate and reliable in-flight capability for measuring intraocular pressure.
 - **Ultrasound** – explore capabilities of current on-board system for monitoring ocular health.



Past In-Flight Capabilities (STS)

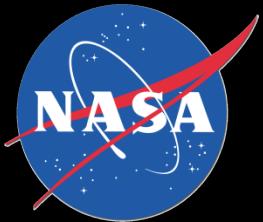
- ❖ Shuttle Experiment (DSO 474) – Modified Kowa hand-held fundus camera



DSO 474 Retinal Photography
(STS-34)

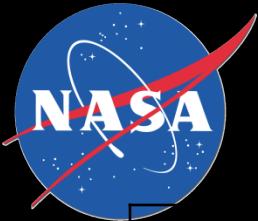


The video fundus camera integrated the Kowa RC-2 fundus camera with the Canon L-1 video camera. This configuration was used during STS-50 for a telemedicine downlink of retinal and optic nerve head video images.



Questions ?





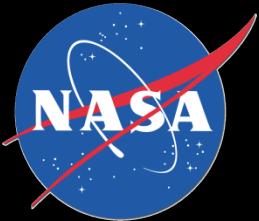
4.6

NASA Vision Standards



EYES

1. Disease of either eye or supporting structure that may interfere with the performance of duties.
2. Lids and Ocular Adnexae
 - A. Any condition of the eyelids that impairs normal eyelid function.
 - B. Chronic blepharitis or blepharospasm.
 - C. Ptosis, unless benign etiology that is not progressive and does not interfere with vision in any field of gaze or direction.
 - D. Growths on the eyelid unless small, asymptomatic, non-progressive and benign.
 - E. Dacryocystitis or history of dacryocystitis.
3. Conjunctivae
 - A. Chronic or recurrent conjunctivitis requires ophthalmic evaluation.
 - B. History or presence of trachoma.
 - C. Xerophthalmia. Other dry eye syndromes require ophthalmic evaluation.
 - D. Pterygium that encroaches on the cornea more than 2 millimeters or recurs after two operative procedures.
4. Cornea
 - A. Chronic or recurrent keratitis requires ophthalmic evaluation.
 - B. History of corneal ulcer or erosion requires ophthalmic evaluation.
 - C. Herpetic ulcer or history of herpetic ulcer.
 - D. Vascularization, haze, or opacification of the cornea from any cause when it is progressive or interferes with vision.
 - E. Corneal dystrophy of any type, including keratoconus of any degree.
 - F. History of orthokeratology treatments within the previous six months. Prior orthokeratology requires ophthalmic evaluation.
 - G. History of penetrating or lamellar keratoplasty.



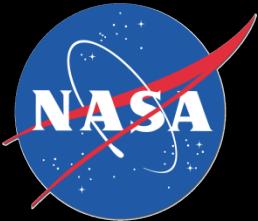
NASA Vision Standards

- H. Corneal implantation.
- I. Refractive surgical procedures other than the following:
 - a. PRK or any variant of excimer laser surface procedures
 - 1. Pre-op cycloplegic refractive error shall be between +4.00 to -8.0 sphere and astigmatism shall be 3.00 D or less in minus cylinder format.
 - 2. No less than 1 year post-op (including enhancements) with no permanent adverse sequelae
 - b. LASIK
 - 1. Pre-op cycloplegic refractive error shall be between +4.00 to -8.0 sphere and astigmatism shall be 3.00 D or less in minus cylinder format.
 - 2. No less than 1 year post-op (including enhancements) with no permanent adverse sequelae
- 5. Uveal Tract
 - A. Acute, chronic or recurrent inflammation of the uveal tract (iris, ciliary body, choroid). History of uncomplicated post-traumatic iritis requires ophthalmic evaluation.
- 6. Retina and Vitreous
 - A. History or presence of retinal detachment, unless traumatic with no sequelae, retinal tears, or edema.
 - B. Retinal hole with presence of fluid or vitreous traction. Other retinal holes require ophthalmic evaluation.
 - C. Degeneration or dystrophies of the central or peripheral retina, including lattice degeneration, require ophthalmic evaluation.
 - D. Pigmentary degeneration requires ophthalmic evaluation.
 - E. Retinitis, chorioretinitis, or other inflammatory conditions of the retina, unless single episode which has healed and does not impair central or peripheral vision.
 - F. Hemorrhages, exudates, or other retinal vascular conditions that potentially impair vision require ophthalmic evaluation.
 - G. Vitreous opacities or conditions that may cause loss of central acuity or peripheral visual field require ophthalmic evaluation.



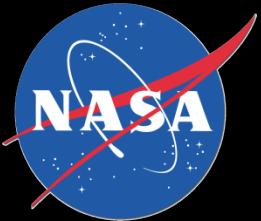
NASA Vision Standards

7. Optic Nerve
 - A. Presence or history of optic neuritis.
 - B. Optic atrophy, primary or secondary.
 - C. History of papilledema, pseudopapilledema, or papillitis requires ophthalmic evaluation.
 - D. Congenito-hereditary conditions, including optic nerve drusen, that may interfere with central visual acuity or visual field.
8. Lens
 - A. Aphakia.
 - B. Lens opacities that interfere with vision or are considered progressive require ophthalmic evaluation.
 - C. Lens dislocation, partial or complete.
 - D. Intraocular implants or intraocular contact lenses.
9. Other Defects and Disorders
 - A. History or presence of malignant tumors in the eye or orbit.
 - B. Resected basal cell cancers or benign tumors require ophthalmic evaluation.
 - C. Exophthalmos, anophthalmos or microphthalmos.
 - D. Pathologic nystagmus.
 - E. Diplopia.
 - F. Abnormal pupil(s) or loss of normal pupillary reflexes requires ophthalmic evaluation.
 - G. Coloboma.
 - H. Any organic or congenital disorder of the eye or adnexa not previously specified that threatens to impair visual function.



NASA Vision Standards

10. Refractive standards: inability to meet the following refractive standards
 - A. Near and distant vision uncorrected or correctable to 20/20 or better in each eye.
 - B. Refractive error: (distant vision): Pilot
 1. Cycloplegic refractive error of more than +3.50 or -4.00 diopters in any meridian.
 2. Astigmatism requiring more than 2.00 diopters of cylinder correction.
 3. Anisometropia of more than 2.50 diopters
 - C. Refractive error: (distant vision): MS, PS, and SFP
 1. Cycloplegic refractive error of more than +5.50 or -5.50 diopters in any meridian.
 2. Astigmatism requiring more than 3.00 diopters of cylinder correction.
 3. Anisometropia of more than 3.50 diopters
11. Visual Fields: All visual field defects require ophthalmic evaluation.
12. Extraocular muscle balance
 - A. Esophoria greater than 10 prism diopters measured at 6 meters.
 - B. Exophoria greater than 10 prism diopters measured at 6 meters.
 - C. Hyperphoria greater than 2 prism diopters measured at 6 meters.
 - D. Any heterotropia measured at any distance.
 - E. Point of convergence (PC) greater than 100 millimeters requires ophthalmic evaluation.
 - F. Paralysis of ocular motion in any field of gaze.
 - G. Any diplopia or suppression in the red lens test that develops within 50.8 centimeters (20 inches) from the center of the screen in any of six cardinal directions requires ophthalmic evaluation.



NASA Vision Standards

13. Depth Perception: Lack of adequate stereopsis on objective testing. (Candidates must pass the Optec 2300 depth-perception or Verhoeff or Randot tests.)
14. Unsatisfactory night vision as determined by history and confirmed by objective testing.
15. Color Vision Deficiency: Inability to pass red-green or blue-yellow color vision testing.
16. Intraocular Pressure
 - A. Glaucoma, identified by pressure greater than 30 mmHg in either eye, characteristic glaucomatous change in the optic nerve or visual field loss characteristic of glaucoma.
 - B. Preglaucoma, identified by pressure on two determinations equal to or greater than 25 mmHg or a difference greater than 4 mmHg between eyes.
 - C. Pigmentary Dispersion Syndrome requires ophthalmic evaluation.
17. Medically required use of a contact lens.